

Al Gross

A master's touch, a president's miracle

In America's war against Hitler, President Franklin D. Roosevelt, with his intelligence team already stretched to its limit, ordered the seemingly impossible — more, better, faster information from behind enemy lines. An Ohio ham radio operator responded with ingenuity that met the challenge, stumped the Gestapo, and sent the world headlong into a new era of radio.



By Wayne Mishler



In a chilly February morning in an obscure shop in Youngstown, Ohio, a tiny radio was coming into the world. Not just any radio. This was a radio beyond the technology of 1945, with capabilities unknown to anyone but the master who had designed it: a radio destined for high drama behind enemy lines in embattled Germany.

The birth process took three and a half hours. The master's fingers worked precisely, soldering components into a metal box the size of a man's hand. When finished, he connected the radio to a small battery pack. Four tiny vacuum tubes responded with a friendly glow. Then came alignment and tuning, and the radio was packed for shipping. Destination: top secret.

Editor's note: Details of this article were taken from top-secret documents declassified in 1976. To bring the story to life, the events were recreated as they might have happened a half century ago. Agent code names and the exact words of their reports are quoted from a July 6, 1945, secret memorandum signed by Charles S. Cheston, acting director of the U. S. Office of Strategic Services (OSS), forerunner of today's Central Intelligence Agency. The documents are from the files of Mr. Al Gross, whose technical genius surpassed the keenest minds of his day, including the German engineers of World War II. By achieving circuit stability at ultra-high frequencies, which the Germans could not do (nor could anyone else), and by packing his vacuum tube technology into a fistful of radio that OSS agents could carry unseen behind enemy lines, Gross contributed immeasurably to the defeat of Hitler's dreaded Nazis in the closing months of the war, and is accredited with inventing and developing portable two-way radio communication as we know it today. He has been honored on numerous occasions as the pioneer of modern Personal Communications Systems. At our request, Gross opened his files and allowed us to write this untold portion of his story.

■ Behind enemy lines

On the other side of the world, behind enemy lines in Munich, Germany, Freddie took a last puff on an American cigarette. Freddie was his code name of course. He was in his 30's. Skinny. And gutsy, to the point of being cocky. Maybe too cocky for his own good. Maybe that's why he was here in Hitler's world of terror instead of being with his wife and baby back in the states. The thought of it sometimes hurt. Late at night especially, when Freddie was trying to sleep, he wept in secret. Tears were not becoming to a spy.

Freddie flipped the half-burned cigarette onto the ground, stepped on it, and exhaled a cloud of white smoke and breath into the freezing afternoon air. Not smart, leaving evidence on the ground for the Gestapo to find. Freddie knew that of course. It was his way of adding risk to the game. He was good at it. Too good to get caught. Or so he thought.

He casually walked out of the crowd at Pasing station, a railroad depot in Munich, and ducked into a nearby bombed-out ruin with no roof. Beneath his knee-length coat was a small battery pack and a top-secret radio so advanced even by 1945 standards that few men had ever seen it. Fewer still had used it in the war. Some said the prototype had been ordered into production by Roosevelt himself, and that it was being manufactured secretly by an inventor somewhere back in the states. Not even the secret agents knew who or where. It was a matter of national security.

Inside the ruin, Freddie climbed over debris and filth to a spot where he could sit. The walls had been blackened by fire. A charred shoe lay in the corner. Freddie wondered if there was a foot in it, but he didn't look. He checked his watch. It was time. He took the two-way radio from beneath his coat, connected it to the battery pack, and the radio's four tiny vacuum tubes warmed to operating temperature. The radio looked deceptively simple: a plain black rectangular metal box scarcely bigger than a man's hand. Two knobs controlled its operation. Its tiny antenna, Freddie was told, would send a narrow half-watt signal straight up to aircraft passing overhead.

"Where the hell are they?" he wondered.

He did not want to linger in the ruin. Detection would be hard to explain. Especially with an American accent. Although he had been assured otherwise, Freddie wondered if the Germans would hear his transmission. The Gestapo's direction-finding ability was feared even within the Reich itself. But the U. S. Office of Strategic Services had said the Germans could not tune their receivers to 250



The wooden British Mosquito bomber.

MHz, the frequency at which the radio operated. In Freddie's mind, the possibility that the experts could be wrong added intrigue to the game. For Freddie, intrigue was strangely enjoyable. He wondered if Bobby had felt the same thrill of adrenaline.

Bobby was the code name of an agent who had parachuted into Holland the previous November with a radio like Freddie's to set up an underground railroad for sneaking OSS agents into Germany. The Gestapo captured Bobby. It happened just days ago. According to official reports, the enemy had not detected Bobby's radio signal. Apparently they had stumbled onto him by accident. But the end result was the same. They had Bobby. And they had his radio.

Sounds carry well in cold, calm air. And in the heavy silence of the ruin, Freddie heard an approaching aircraft. The plane was high. The droning of its engines grew louder. In minutes the plane was overhead, a dot barely discernable through the milky atmospheric haze. Even though it was late, Freddie knew this was his rendezvous. He had been told to expect a British Mosquito twin-engine bomber flying at 30,000 feet, above the reach of German guns. Freddie brought the tiny radio to his face, took a breath, thought of Bobby, and pressed the transmit button.

"Hello Vic. This is Freddie calling."

"Roger. What you got?"

"Vic, the Weilheim railway junction has from forty to fifty trains passing through all night. In Weilheim proper there are two airplane factories. Number 1 is the Dornier works and the second is a factory making

spare parts for planes.

"Peissenberg is nearby. It is the last coal mine out of which the Germans are now obtaining coal within the Reich to send to Berchtesgaden. The spare airplane parts from the Dornier plant are shipped by rail to Garmisch in the Mountains.

"You must absolutely knock out the railway line as soon as possible. This line must be knocked out.

"I have something else to say to you. You must not bomb Raisting under any circumstances. The people there are ninety percent on our side and so is the entire Volkssturm. Raisting, Raisting, do not bomb it, please."

"Roger."

Death from the sky

As a precaution, in case the Germans were listening on Bobby's radio, Freddie intentionally had not mentioned his location. He rose on feet that were numb from the cold, walked painfully out of the ruin, and disappeared into the crowd at Pasing station.

Six miles overhead, a radio operator sitting cramped in the tail section of a Mosquito bomber was playing back a recording of Freddie's transmission, and relaying the information to Air Force headquarters in London. The orders came back quickly, a man's voice crackling in the operator's headphones: "Bomb the Weilheim target. And bomb the Pasing railway station."

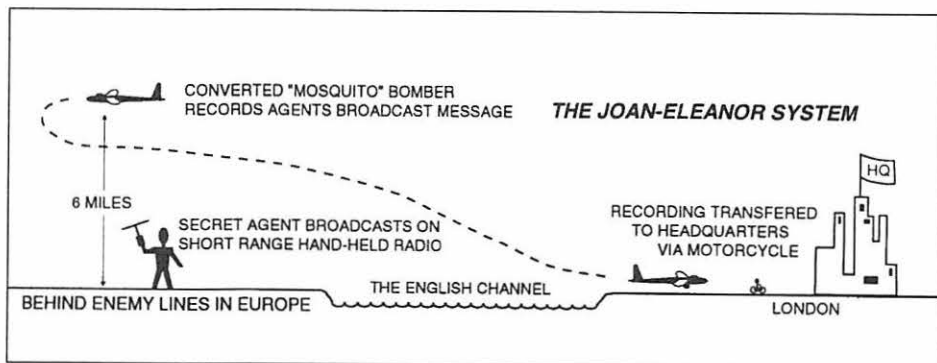
"Roger. Out."

The Mosquito released its bombs into the crowd where Freddie walked incognito, thinking about Bobby, home, wife, and baby.

■ The business of war

The next morning in Washington an OSS official, unaware of Freddie's fate, presented a transcript of the recording to Roosevelt. The president grinned. "Get Churchill on the line. Tell him I've got news."

As Roosevelt spoke with the prime minis-



Drawing copied from a top-secret OSS wartime document of 1944.

ter, the creator of the mysterious radio that had delivered the vital intelligence was arriving for work as usual at his unlikely shop in Youngstown. The day's agenda: produce more radios for the OSS.

The creator was an unpretentious man, even though in his own subtle way he was affecting the outcome of the war. Al Gross was exemplary of amateur radio operators of the day: in love with electronics, curious about how circuits behaved, and energetic. He believed in the premise that amateur radio had been sanctioned by the government to produce a pool of trained radio operators. He was one of the institution's most prolific members.

More than a hobbyist, he was an experimenter. He began exploring radio at age nine, in 1927. Gross got his amateur radio license while in junior high school, and quickly moved out on the cutting edge to experiment with frequencies of 100 MHz and higher. Making circuits stable at such high frequencies was not easy with the vacuum tube and paper capacitor technology of the 1940s. But Gross was soon building hand-held transceivers that operated at 300 MHz.

■ Call to duty

Word of Al Gross' work in UHF soon found its way through the amateur radio grapevine to William Donovan, chief of the OSS, who at the time was being pressured by Roosevelt to produce more, better, and faster intelligence. "I want to get battlefield information before anyone else," Roosevelt told Donovan. "Find a way to get it."

It was asking for a miracle. The OSS already had agents operating behind enemy lines, struggling with limited technology. Telegraphy was their only way to transmit information. Morse code was slow. The equipment was not easy to move or conceal. And the HF transmissions were vulnerable to detection. Donovan needed smaller radios with two-way voice capability that the enemy could not detect, and he thought of Al Gross.

At Donovan's invitation, Gross flew over the war zone on a B-17 bomber equipped with radio detection equipment, and discovered that no one was using frequencies above 180 MHz. He suggested the use of hand-held UHF radios, similar to those he had created.

■ The plan comes together

Donovan took it from there. The OSS would set up a shop where Gross could manufacture his radios in secret. Agents would carry the radios behind enemy lines. Aircraft would fly from London to rendezvous points over Hitler's Germany and agents would radio war intelligence to the aircraft. The messages would be

recorded and flown to a London airfield. Couriers on motorcycles would shuttle the recordings from the airfield to headquarters where they would be transcribed and transmitted to Washington. The project would be called the "Joan/Eleanor" (J/E) operation.

The search began for suitable aircraft. A metal fuselage would attenuate radio signals, but there was a wooden British aircraft that just might work—the Mosquito bomber. Powered by two 1,480 horsepower Rolls-Royce (Packard) Merlin 33 V-12 engines, the Mosquito was so fast that it presumably did not need defensive armament. It could fly 369 miles per hour at altitudes exceeding six miles while carrying the bomb-load of a B-17. For the J/E project, three Mosquitoes were requisitioned and their tail sections modified to carry oxygen, wire recorders, J/E radios, and radio operators.

■ The master's secret

Gross wanted to set up shop in his home town of Cleveland, but government regulations would not allow it, for security reasons. Instead the OSS purchased a machine shop in Youngstown which was already making BNC connectors for the government. The shop was equipped to make the J/E radio housings. A nearby wood frame house was included in the acquisition. Antennas were installed in the attic for testing the radios. The shop and house were connected by a tunnel, so materials could be shuttled back and forth underground between the two structures without arousing curiosity in the neighborhood. A small work force of local civilians were hired to help assemble the radios. The workers knew only that they were assembling radios; they were not told why. Nor were they told of the secret technology in the radios which enabled them to achieve frequency stability in the UHF spectrum.

Actually there were several reasons for the radio's stability. One was its unique front-end design and mechanical method for switching between transmit and receive. "The radio used a modified Armstrong circuit to provide receive in one position and transmit in another," Gross says. Another reason for the stability—and perhaps the most important—was the way the tubes and supportive components were mounted inside the radio. They were physically attached to a ceramic plate, and their leads were soldered to metallic traces printed on the plate (Gross' own 1945 version of today's printed circuits.) This kept the RF leads short and rigid. "The rigidity offered by this arrangement tremendously increased the frequency stability," Gross explains.

Powered by a small pack of two 65-volt "B"

batteries in series and two 1.5-volt "D" cells, the tiny transceiver sent two watts of voice-modulated signal via a vertical quarter-wave feed to a horizontal half-wave dipole. After losses, the antenna, which resembled a "T" when attached to the top of the radio, radiated a directional half-watt signal upward toward overhead aircraft.

"Yes, the antenna was directional, as all dipoles are when used horizontally," Gross says. "A half-watt output was the best I could get with 135 volts at .015 ma, considering the inherent coupling and transmission line losses. The battery life was good for about eight to ten days of intermittent operation."

The radio was plain to look at. Gross had designed it with simplicity and dependability in mind. Its dark metal housing was about the size and shape of a brick, slightly thinner, and of course much lighter in weight. On the upper portion of its face was a metal tag with model and serial numbers. In the center there were two knobs, and beneath them a circular perforated plate through which voice passed to a microphone. The knobs were the radio's only controls. "One control was for tuning. The other was for low frequency injection to control sensitivity and volume," Gross says. Earphones and the battery pack were connected to the radio through jacks in the bottom.

The PC-like construction process made the radios relatively easy and fast to assemble. Gross and his crew were turning them out at the rate of one every three and a half hours on the morning that Roosevelt received Freddie's report from Munich.

■ Death denied

At lunchtime in Ohio that day, darkness was spreading over Germany, and a radio operator riding in the tail of a Mosquito bomber was putting on his earphones. An aircrewman signaled to him that they were over Munich. And there, booming in the circuitry designed by Al Gross, was the voice of secret agent Freddie.

"I want to thank you for almost killing me yesterday," he said. "I was at the Pasing station when you bombed it."

"Now, I have an up-close and very personal eye witness damage report for you. The station was hit directly. Railroad traffic in the direction of the mountains and Garmisch was halted, and is paralyzed. All tracks are destroyed. Raisting was untouched."

More good news for the president, whose miracle at that moment was producing another secret radio, in an obscure shop, in an unsuspecting neighborhood, in the vast American mid-west: a speck on a map. There was no applause. None was expected. This was duty. This was patriotism.

Al Gross Profile

Pioneer of Radio and PCS Looks at its Past and Future



By Wayne Mishler

The man who pioneered today's telecommunications revolution may be one of America's greatest unsung heroes.

Al Gross, amateur radio W8PAL, inventor, electrical engineer, visionary, industry statesman, is the kind of man you would expect to find sitting in robes on the peak of a mystic mountain, speaking pearls of wisdom.

When he speaks, people listen. And things happen. He has been the spark and the inspiration for two-way radio, personal pagers, cordless and cellular telephones, satellite telecommunications, military weaponry, and more. For most of his life, Al Gross has been so far out on the leading edge of technology that he has not been privileged to talk about his achievements. To do so would risk compromise of patents or military intelligence — intelligence as in the cloak and dagger spy game. Yes, there is a clandestine side of Al Gross.

There is an old axiom that says the "squeaky wheel" gets the grease. Al Gross has never been a "squeaky wheel." It is not his nature. He's a doer and not a talker. And perhaps because of this, although you'll never hear it from Gross, America has never paid — nor could it ever pay — the debt it owes him.

"My wife was reminding me just the other day how much money we might have if my patents were still in force," he says. "They

expired long ago." And then he laughs. "Oh well, I'm happy picking oranges in my back yard."

A native of Cleveland, Ohio, Gross today lives a modest life in sunny Arizona, where he continues his work in electronics as a senior staff electrical engineer with the Orbital Sciences Corporation. At age 79, he is active in developing space systems, launch vehicles, satellites and space sensors for a world-wide market. Some of the products with which he is involved include the delta-winged Pegasus launch vehicle, the medium payload Taurus launch vehicle, smaller suborbital rockets, and the next generation X-34 reusable launch vehicle.

"With the creativity of more than 3,000 of

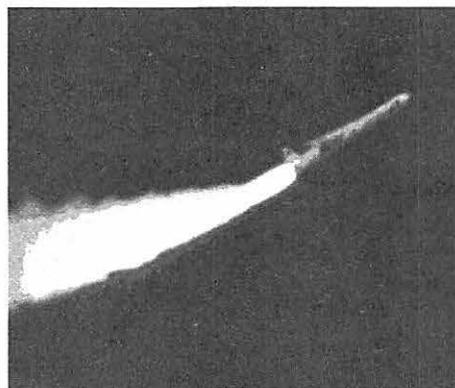
the top engineers, scientists, technicians and other professionals in the space and information industries," says Orbital president and CEO David W. Thompson, "Orbital is opening the doors to space for an increasing number of commercial, scientific and defense customers in both domestic and international markets." That lineup of course includes Al Gross, who characteristically is not privileged to discuss the details of his work.

"My current work in satellite launching systems mandates keeping out of the limelight," Gross says. He's been saying things like that since World War II, with good reason.

Gross worked in secret to produce technology that helped America and its allies win the war. And when the war ended, the obscure shop in Youngstown, Ohio, where he produced his J/E "spy" radios for the OSS (the forerunner of today's Central Intelligence Agency) was torn down, probably for security reasons. His work with the spy radios was reduced to papers in top secret government files.

"We used to joke that OSS stood for Oh So Secret," he says. "Not long after the war there was a spy movie with Alan Ladd playing the main part."

The end of the war, however, was just the beginning of this inventor's career, and of his contributions to civilian and military communications and weapons technology. Over the



Pegasus air-launched space vehicle.

years Gross has become well known, if not famous, for those contributions, and especially for his role in pioneering the technology of today's personal communications systems.

"My archives fill a room 30 feet long," he says. "Someday I'll donate them to a museum. Maybe I'll write my memoirs." Then he laughs.

Even Al Gross isn't sure of how many patents he has filed away in those archives. He presented *Monitoring Times* with copies of four different patents on the J/E radio alone. "I have some 95 World War Two bomb fuse patents in my files," he says. Some of those are from the work he did to develop devices to control the detonation of bombs, missiles, mortar shells, and similar weapons for the military.

He has video tape of a WWII newsreel showing the fuses in action. These were ingenious devices which delayed the arming of warheads until they were well on their way to targets, and then determined where they would explode with respect to their targets. They were forerunners of today's "smart" bombs which proved to be so effective in the Persian Gulf war. When a warhead explodes on impact with the ground, its shrapnel passes over personnel in foxholes and equipment behind sandbags. So the military developed fuses that internally generated a radio frequency field. When this field came in proximity to ground or water, it detonated the warhead in the air, prior to impact, blasting shrapnel into fox holes and behind protective barriers. "Maybe we'll do an article on that one of these days," Gross says.

The Federal Communications Commission learned of Gross' innovations and wanted to know more because they were responsible for detecting electronic "bugs" and similar devices. Gross briefed the FCC on his J/E radios, in February 1945, and (then) Commissioner E.K. Jett was so inspired that he wrote an in-depth article for the *Saturday Evening Post*, entitled "Phone Me By Air." The Post published his article which portrayed to the American public a vision of life transformed by radio links at home and in business. It was Jett's words, but it was Gross' vision.

After the war, Gross formed his own company, Citizens Radio Corporation, to manufacture hand-held two-way radios for civilian use. These radios were similar to those he had manufactured for the OSS, except they operated at 224 MHz to conform to FCC requirements, and were marketed under the brand name "Airline", mostly to farmers.

The small radios caught the eye of cartoonist Chester Gould, creator of the Dick Tracy comic strip. He visited Gross, developed the idea of a miniature wrist radio for his star



One of Gross' many patents

cartoon character, and published the first episode with Tracy wearing the wrist radio, in October, 1948, inspired of course by the vision of Al Gross.

In response to a suggestion by a hospital patient, Gross in 1949 developed a prototype of a modern pager for the medical industry. In 1952, Gross received FCC certification for a one-way signaling system for hospitals. He sold the rights to the pager and to his two-way radio that year to Motorola. It was time to move on to other milestones. To name a few:

- The Pioneer Award for "landmark contributions to the wireless industry," presented by the Personal Communications Industry Association.
- The Marconi Memorial Gold Medal of Achievement, awarded by the Veterans Wireless Operators Association.
- Special honors from the Institute of Technology and Higher Education Amateur Radio Club at its annual symposium in Monterrey, Mexico, at which Gross spoke on the history of the walkie-talkie, cordless telephone, cellular phone, and radio paging.
- Honorary membership in the International Telecommunications Union at the 9th Personal Radio Congress, Geneva, Switzerland, in 1995.

Gross refers to the ITU event as "my super trip to Geneva. It was a 'show and tell' for some 250 attendees representing about 30 countries. They gave an evening party for me. I was not told what was going to hap-

pen. They gave me the 1995 ITU Anniversary Special Recognition Award ... permanent honorary membership in ITU for pioneering and contributing to mobile and personal wireless telecommunications now in use worldwide."

Worldwide! Gross beams when he tells about it. "This was a keystone of my 65 years in radio," he says.

Today, as an electrical engineer with Orbital Sciences Corporation, and statesman in the worldwide telecommunications industry, Gross is in a position to foresee the future of space development, space-borne telecommunications, and personal communications systems. "It's a great pleasure to have an 'ear' to what is going on in the industry," he says.

Still a ham radio operator at heart, Gross also has insights of where the changing radio hobby is headed.

"The changes may seem like runaway technology today, but I assure you they are no different than when I was a kid in ham radio. I thought learning 13 words a minute to pass the code test for my ham ticket was high technology, not to mention drawing (an electronic diagram) and explaining it.

"Radio is going through a face change, with the introduction of the computer, cellular, cordless, radio-paging, packet-radio, e-mail, small dish satellite and cable TV, the Internet, and more yet to come. Ham radio and scanners will keep up. I observe that Radio Shack sales of ham and scanner gear has not declined. Perhaps that's a good barometer."

Then he mentions the recent controversy that seemingly threatens the very existence of scanners: the Florida couple who intercepted and made public a cellular phone conversation between House Speaker Newt Gingrich and his colleagues. "I've got an easy solution for that," he says. "It's laying right here on my desk: a simple way to keep scanners from intercepting cellular calls. There's no need for talk of banning them. There's no need for encryption. My solution will make it impossible for anyone to modify a scanner without destroying its circuitry. I doubt that I'll market it. I won't tell you what it is. But maybe..."

He didn't finish the sentence. You could tell it was intentional. That's the enigmatic side of Al Gross, who still carries a flame for mystery, intrigue, the unknown. Just don't be surprised if you hear about a new breakthrough in scanner technology in the news tomorrow.



1948 Cleveland Plain Dealer cartoon, inspired by Gross.